

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

1. (Currently Amended) A method for optimal multimedia content delivery over networks from a server to one or more clients, comprising:
 - delineating a state variable that represents ~~[[the]]~~ a data rate to each client;
 - delineating a set of conditions which represent ~~[[the]]~~ time-varying constraints on the data rate of said multimedia content said conditions including:
 - (1) the total data rate for all clients does not exceed the maximum throughput of the server or network, whichever is least;
 - (2) the data rate from server to client does not exceed the maximum data rate for the client;
 - (3) the data rate of the client will never overflow ~~[[the]]~~ a client buffer;
 - (4) the server will never underflow; and
 - (5) the data rate from the server will never be less than the client's minimum data rate, which is a non-increasing function of time obtained by dividing the content not yet delivered by the remaining play time;
 - delineating a cost function which represents the value of a proposed solution; and
 - performing periodic computations in compliance with conditions (1) - (5) to obtain a state value that maximizes said cost function.
2. (Previously Presented) A method as in claim 1, wherein said conditions further include
 - (6) the current maximum client data rate is given by the minimum of:
 - the stored initial maximum client data rate;
 - the data rate required to fill the remaining client buffer during the current of said periodic computations;

the data rate required to complete the delivery of said multimedia content;

the client data rate never exceeds said current maximum client data rate.

whereby said current maximum client data rate is periodically recomputed to maintain an optimal solution over a given period of time.

3. (Previously Presented) A method as in claim 2, wherein:
said cost function represents maximal throughput and is given by the sum of said client data rates for all active clients.

4. (Previously Presented) A method as in claim 2, wherein:
said cost function represents maximal charge and is given by the sum for all active clients of said client data rates times the client's cost of service.

5. (Previously Presented) A method as in claim 3 for bandwidth allocation for delivery of multimedia data from server to one or more clients over a network, comprising the steps of:

determining the maximum flow rate and minimum flow rate for each client;
determining the flow rate range for each client as given by the difference between said maximum flow rate and said minimum flow rate;

initializing current flow rate for each client as said minimum flow rate and summing said flow rate into total server flow rate; and

allocating remaining server bandwidth to remaining clients until they each saturate or no bandwidth remains.

6. (Currently Amended) A method as in claim 5 wherein said step of allocating remaining server bandwidth to remaining clients comprising:

sorting the list of clients according to said flow rate range;
determining equally-allocated remaining server bandwidth if allocated evenly to all remaining unprocessed clients [[and]];

determining the range of remaining client bandwidth as given by the difference between said maximum flow rate and said minimum flow rate; [[and]]

determining saturation by comparing said equally-allocated remaining server bandwidth and said range of remaining client bandwidth, and allocating the lesser of these two amounts to each remaining client flow rate; and

whereby allocating flow to remaining clients based upon the sorted client range flow rates and determining allocation of remaining server bandwidth based upon a comparison of saturation of server versus saturation of each client maximizes allocation of total bandwidth for maximal flow rate to maximum number of clients.

7. (Previously Presented) A method as in claim 4 for bandwidth allocation for delivery of multimedia data from server to one or more clients over a network, comprising the steps of:

determining the maximum flow rate and minimum flow rate for each client;
determining the flow rate range for each client as given by the difference between said maximum flow rate and said minimum flow rate;

sorting the list of clients according to said flow rate range;

initializing current flow rate for each client as said minimum flow rate and summing said flow rate into total server flow rate; and

allocating remaining server bandwidth to remaining clients such that lower paying clients receive bandwidth only if higher paying ones are saturated.

8. (Previously Presented) A method as in claim 7 wherein said step of allocating remaining server bandwidth to remaining clients comprises the steps of:

for each remaining unprocessed client:

determining equally-allocated remaining server bandwidth if allocated evenly to all remaining unprocessed clients;

determining the range of remaining client bandwidth as given by the difference between said maximum flow rate and said minimum flow rate;

determining saturation by comparing said equally-allocated remaining server bandwidth and said range of remaining client bandwidth, and allocating the lesser of these two amounts to each remaining client flow rate; and

whereby allocating flow to remaining clients based upon the sorted client range flow rates and determining allocation of remaining server bandwidth based

upon a comparison of saturation of server versus saturation of each client maximizes allocation of total bandwidth for maximal flow rate to maximum number of clients.

9. (Currently Amended) A method for connection acceptance control for delivery of multimedia data from server to one or more clients over a network, comprising the steps of:

determining server swing capacity given by the difference between the total server bandwidth and the sum of the minimum flow rates of all currently-connected clients; and

allocating server bandwidth for each prospective client which will fit without server bandwidth saturation, as determined by comparing an average data play rate of each prospective client with the remaining bandwidth, represented by said server swing capacity, available to the server,

wherein the minimum flow rate for each client is expressed as a non-increasing function of time obtained by dividing content not yet delivered by remaining play time, and wherein the minimum flow rate ensures that all required content will be available to each client when needed.

10. (Original) A method as in claim 9 wherein said remaining bandwidth available to the server is given by said server swing capacity.

11. (Previously Presented) A method as in claim 10 wherein said remaining bandwidth available to the server is give by said server swing capacity less a server flow safety margin, thereby allowing server capacity to be subsequently lowered by up to the safety margin without requiring load shedding, and without affecting client sessions in process.

12. (Previously Presented) A method as in claim 9 wherein said step of allocating server bandwidth for each prospective client which will fit without server bandwidth saturation comprises:

allocating server bandwidth to each prospective client sequentially until a prospective client is located in which said average data play rate exceeds said server swing capacity.

13. (Previously Presented) A method as in claim 9 wherein said step of allocating server bandwidth for each client which will fit without server bandwidth saturation comprises:

allocating server bandwidth to each prospective client sequentially for each client which can be activated without server bandwidth saturation.

14. (Currently Amended) A method for bandwidth allocation for delivery of multimedia data from server to one or more clients over a network, comprising:

storing a sequence of data representing scheduled bandwidth changes for the server;

determining the maximum flow rate and minimum flow rate for each client at the present time, the determination of the minimum flow rate being based on a non-increasing function of time obtained by dividing content not yet delivered by remaining play time, and wherein the minimum allowed flow rate ensures that all required content will be available to each client when needed;

determining the flow rate range for each client as given by the difference between said maximum flow rate and said minimum flow rate;

sorting the list of clients according to said flow rate range;

initializing current flow rate for each client as said minimum flow rate and summing said flow rate into total server flow rate; and

allocating remaining server bandwidth to remaining clients.

15. (New) The method of Claim 1, wherein the data rate ensures that all required content will be available to each client when needed.